The Monthly Evening Sky Map

A SCIENTIFIC JOURNAL AND EDUCATIONAL GUIDE IN ASTRONOMY FOR THE AMATEUR

Founded in 1905 by Leon Barritt

ALSO A STAR, CONSTELLATION AND PLANET FINDER MAP ARRANGED FOR THE CURRENT MONTHS - MORNING AND EVENING - AND PRACTICAL ANYWHERE IN THE WORLD

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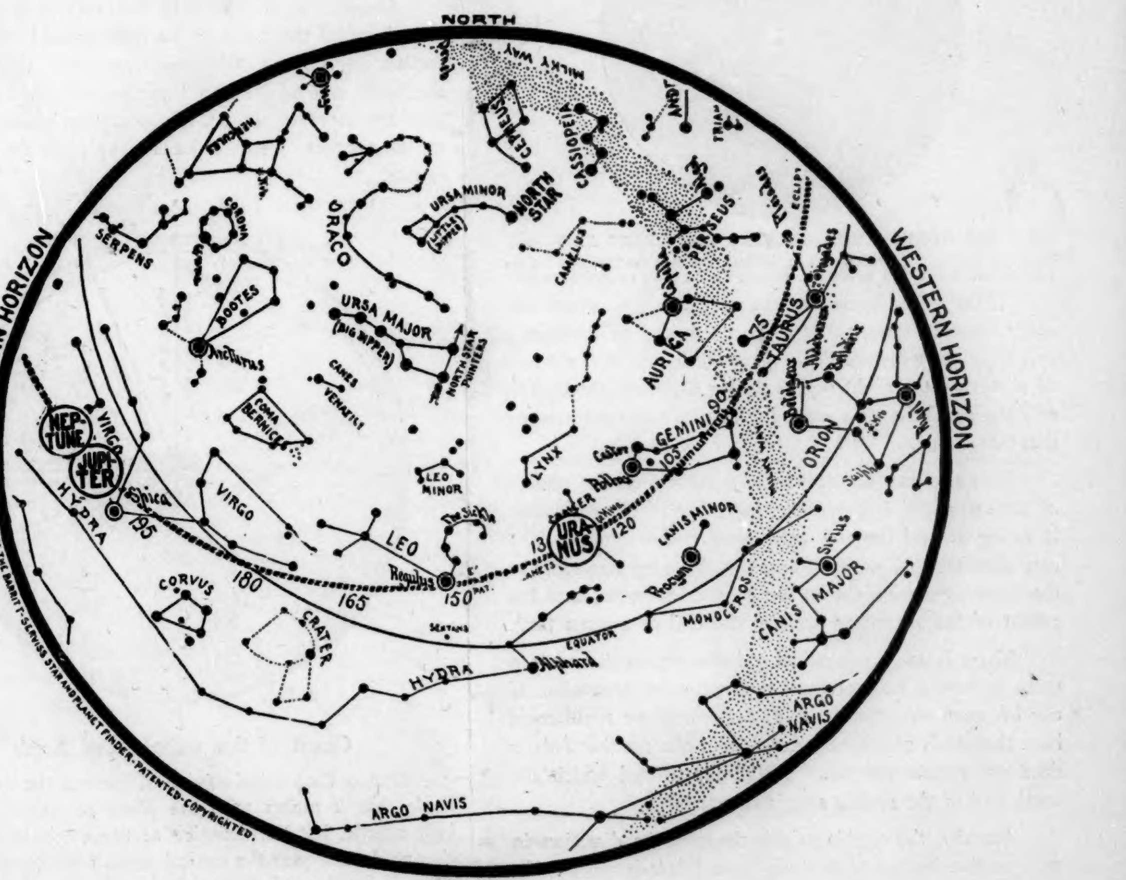
EVENING SKY MAP FOR APRIL



AT 9:00 P.M., APRIL 1 8:30 P.M., APRIL 15 7:30 P.M., APRIL 30

Face South and hold the Map overhead, the top North, and you will see the stars and planets just as they appear in the heavens. The arrow through the two stars in the bowl of the Big Dipper points to the North Star, the star at the end of the handle of the Little Dipper.

This map is arranged specifically for Latitude 40 North—New York—but is practical for ten or fifteen degrees north or south of this latitude anywhere in the United States; the southern portion of Canada and the northern portion of Mexico and for corresponding latitude in Europe.

THAT PECULIAR EARTH MOTION—PRECESSION

By C. A. ATWELL

The axis on which the earth rotates has a motion that is so slow that its effects cannot be observed in a lifetime without accurate astronomical measurements. The effects of this motion are quite remarkable although not as commonly understood as the effects of the daily rotation of the earth on its axis to produce day and night, or the yearly revolution around the sun to produce the seasons.

It took the naked eye astronomers thousands of years to commonly believe that the earth moved at all, but today there are few who doubt its daily rotation on its north-south axis or its annual trip in its orbit around the sun.

THE NORTH POLAR HEAVENS 4,000 YEARS AGO
Note that Polaris is far removed from the pole, and that the "Pointers" of the Big Dipper, though still pointing to Polaris, do not point to the North Pole.

Those of us located in the northern hemisphere can easily convince ourselves that the north end of the earth's axis is pointing toward Polaris, the north star. A few hours of observing the night sky or a long exposure photograph of Polaris and the stars around it will help to convince one that this is true.

It is also easy to conclude that, as we on the surface of the earth spin around daily, the globe of our habitation is racing around the sun once every twelve months. The easy observational proof of this the changing star scene at the same time of night as the seasons progress, and the return of the same star scene at the end of a years time.

There is no simple naked eye observation that we can make to convince ourselves of the motion of precession. If our life span were thousands of years or if we could come back thousands of years later, we could observe that Polaris does not remain the point in the sky toward which the north end of the earth's axis is directed.

Actually, the earth's axis is changing its direction in space so that instead of pointing toward Polaris continually, it is directed successively toward all the points on a large imaginary circle among the stars. It completes this circle in 26,000 years. It just happens that we are here when it is pointing close to Polaris. If we should come back in 7500 A.D. the star Alpha Cephei would be seen as the pole star. In 14,000 A.D., the bright star Vega in the constellation Lyra would be the pole star. In 27,958 A.D., Polaris would be it again just as it is now.

The best explanation of this motion called precession is the comparison of the earth's axis with that of a spinning top. If you watch a spinning top, you will notice that the upper end of the axis of the top does not stand still but slowly describes a circle in space. This is more pronounced as the spinning motion is dying down. The axis of the top is cutting out an inverted cone in space. This is also just what the earth's axis is doing very, very slowly as compared with its period of rotation. About 9,490,000 revolutions are required for one conical motion. The apex of the cone described by the earth's axis is at the center of the earth so the complete north and south halves of the axis cut out two cones having the same apex.

If our 26,000 year observations were made from the southern hemisphere we would note the changing southern pole stars in a similar manner as for the north star.

Our seasons are caused by the fact that the earth's axis it inclined to the plane of its orbit around the sun. This inclination is the sizable amount of 23½ degrees. When the north end of the axis leans toward the sun the sun's rays are more direct on the northern hemisphere. This causes summer. When it leans away from the sun winter results.

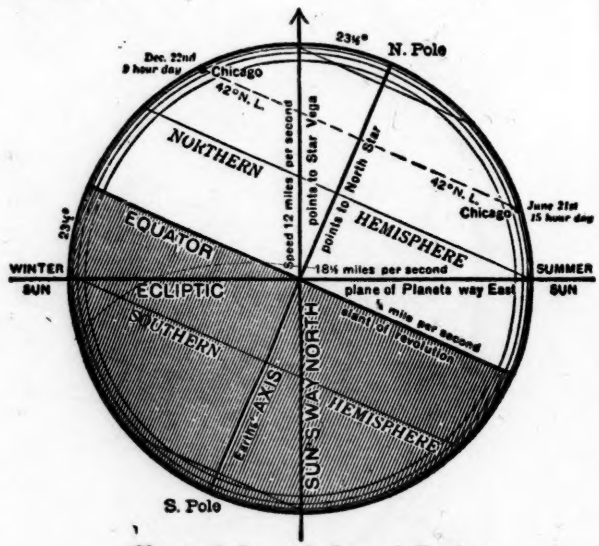
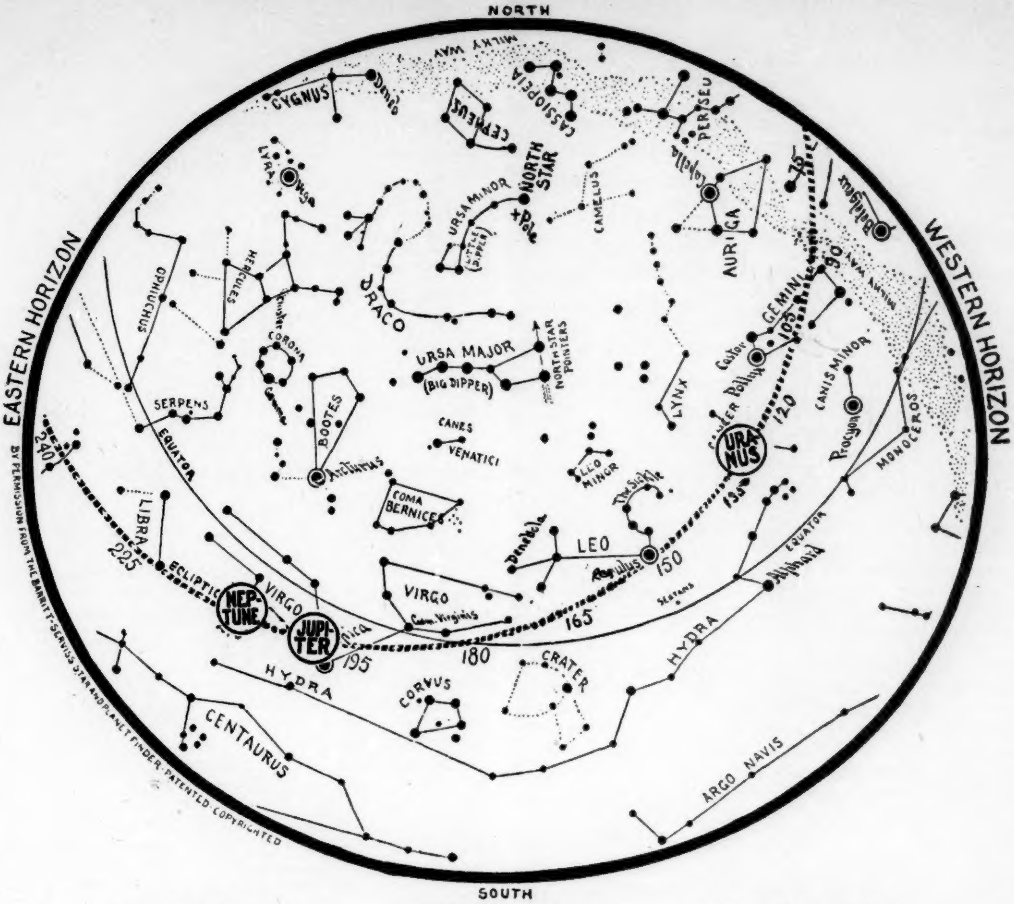


Chart of the unbalanced Earth

During the conical motion of the axis the 23½ degree angle that it makes with the plane of its orbit changes only a little, but the direction of this angle in space does change. In one year the conical motion has completed only a small fraction of its entire period. Consider the point where the axis is inclined the toward the sun. This will occur again twenty minutes less than the actual time required for the earth to make a complete revolution around the sun. Twenty minutes is not much in a year but if this difference were not taken care of in establishing the years length, the seasons would gradually change. On our return in 13,000 years, we in the northern hemisphere would have summer in December and winter in July. The calendar

EVENING SKY MAP FOR MAY



AT 9:30 P.M., MAY 1 8:30 P.M., MAY 15 7:30 P.M., MAY 31

Face South and hold the Map overhead, the top North, and you will see the stars and planets just as they appear in the heavens. The arrow through the two stars in the bowl of the Big Dipper points to the North Star, the star at the end of the handle of the Little Dipper. This map is arranged specifically for Latitude 40 North—New York—but is practical for ten or fifteen degrees north or south of this latitude anywhere in the United States, the southern portion of Canada and the northern portion of Mexico and for corresponding latitudes in Europe.

makers have, however, taken account of this in calculating the calendar year so that we will continue to have the same seasons at the same time of the year. Since calendar years are made up of days, this is done by a very infrequent departure from the common rule that every fourth year will be leap year. Thus the year of the seasons, or the "tropical year", is maintained.

The star constellations will gradually change for a certain season and on our fanciful return in 13,000 years, we would see the same constellations in winter that we now see in summer. In 26,000 years they will again be the same as now.

The effect of precession on the seasons was discovered about 125 B.C., but its cause was reasoned out in much later times by mathematical astronomers.

What is it that causes the peculiar motion of precession? Somehow the earth got to spinning on an axis inclined 23½ degrees to the plane of its orbits. Also it was plastic enough to bulge near the equator because of the greater surface speed there. The moon (and to a lesser degree the sun) tries to attract this bulge into the plane of the earth's orbit. But the forces of the spinning earth resist this attraction. The net result of all the forces involved is the slow conical motion.

Living on this earth would be much more monotonous if its axis were not inclined and no seasons were produced. We can be thankful that it happened that way. As for the effects of precession, we could get along without them and never know the difference. Precession, however, is a peculiarly intriguing motion of our planet and must be taken into account in accurately locating the stars in the sky and in making the calendar year agree with the seasons.

COMET BURNHAM (1958α)

The Lowell Observatory in Arizona reported the discovery on February 22nd of the first comet of 1958, by Robert Burnham, Jr. Magnitude was given as 9 at time of discovery. Subsequent computation of orbit elements reveals perhilion passage on April 16th, at a distance of 123 million miles from the Sun. This comet was closest to the earth the latter part of March, at 77 million miles. At best, it is not likely that this comet will be any brighter than about magnitude 7. As an aid in locating the comet, observers should search Gemini during the first half of April. On the 11th and 12th, the comet is just south (a degree or so) of Pollux.

The

Monthly Evening Sky Map

FOUNDED IN 1905 BY LEON BARRITT

MRS. LEON BARRITT, Editor
Irving L. Meyer, Managing Editor

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AMATEUR'S FORUM

BY IRVING L. MEYER, M. S.

APRIL, 1958

THE SUN: is following the ecliptic in the northern hemisphere, moving from Pisces into Aries. The earth's near-circular orbit varies the Sun's distance from 92.8 million miles the 1st, to 93.6 million miles the 30th.

There is an annular eclipse of the Sun on the 18th, but not visible in North America except for Alaska. The path of the annular phase crosses a portion of the Pacific Ocean, a portion of the Indian Ocean, Formosa, and the Siam-Indo China area. As a partial, the eclipse can be seen from a large portion of the Indian and Pacific Oceans, China, Siberia, India, the East Indies, and, as already mentioned, Alaska and adjacent Canada. See elsewhere in this issue the local times of the circumstances of this eclipse.

THE MOON: is at *perigee* (closest to the earth) the 3rd at a distance of 222,000 miles, and is at *apogee* (farthest from the earth) the 16th, at 252,000 miles.

Libration: Maximum exposure of the regions on the Moon's limbs takes place as follows:

April 10	West limb,	7.4°
April 12	South limb,	6.8°
April 25	East limb,	7.2°
April 27	North limb,	6.8°

The Moon's Phases (E.S.T.):

Full Moon	April 3 at 10:45 pm
Last Quarter	10 at 6:50 pm
New Moon	18 at 10:23 pm
First Quarter	26 at 4:36 pm

MERCURY: retrogrades almost the entire month, in the Pisces-Aries area. It is close to greatest elongation east of the Sun at the beginning of the month, and accordingly will be visible low in the west in the twilight zone, for the first few days of the month. Its swift movement takes it to inferior conjunction with the Sun on the 16th, and thereafter it appears in the morning sky, but too close to the Sun to be observable. At the beginning of the month, Mercury will be a little brighter than a standard first magnitude star, and a small telescope will show the planet's crescent phase. It is closest to the earth the 20th at 53 million miles.

VENUS: is queen of the morning sky. It moves from the Capricornus-Aquarius boundry, through the latter, into Pisces. At the beginning of the month, magnitude is -4.1, diameter is 27", illumination is 45% (crescent phase), and distance is 58 million miles. On the 30th, magnitude is -3.8, diameter is 20", illumination is 60% (gibbous phase), and distance is 79 million miles. Observation of this planet is restricted to the pre-dawn sky, and by its brilliance it is unmistakeable.

MARS: is another morning "star", moving from Capricornus into Aquarius. It is very gradually becoming better placed for observation, coming nearer to the earth and brighter. But it is still far from the earth and, accordingly, small, its diameter averaging 6" during the month. A small telescope (for instance, the K-3 or K-4) will show some detail even now—such as the readily noticeable gibbous appearance. During the month, magnitude increases from 1.1 to 0.9, as distance declines from 154 million miles, to 136 million miles. Mars will be closest in November, and then will be about three times closer to the earth.

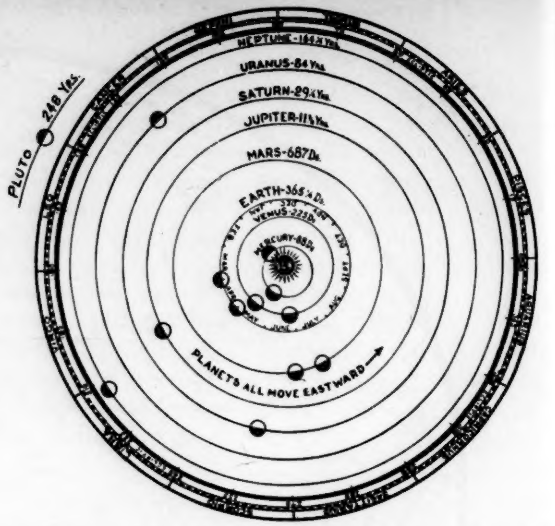
JUPITER: is the finest object in the night sky. It comes to opposition on the 17th, meaning that it will rise at sunset, and set at sunrise, and be best placed for observation at midnight. A brilliant giant, its disc can be made out with binoculars—which will also reveal the four bright satellites. The K-4 telescope gives an excellent view of the disc, revealing the cloud bands, as well as the polar flattening. At opposition, Jupiter shines at magnitude -2.0, equatorial diameter is 44" (3" greater than the polar diameter), and distance from the earth is at a minimum for this year, of 413 million miles. Near Spica, in Virgo, the entire month.

SATURN: in the morning sky, it rises before midnight from a point on the Ophiuchus-Sagittarius boundary. Though best observable from the southern hemisphere, it is still a grand sight in the telescope wherever the observer is located. The ring system is opened to its maximum this year, resulting in increased brightness for the planet as compared with an average opposition. At the middle of this month, the magnitude of Saturn is 0.6, ring diameter is 40", and the diameter of the globe of the planet is 18". A small telescope will reveal the rings. The planet is approaching opposition, which occurs in June.

URANUS: near Praesepe, in the constellation Cancer, sets around midnight. It is well placed for observation, but is so remote that it is, at best, puny as compared to the inner planets. It can just be seen with the unaided eye, under good conditions. Magnitude is 6, apparent diameter 4", and distance (the 15th) is 1693 million miles.

NEPTUNE: also in Virgo, comes to opposition on the 23rd, or about a week after Jupiter. What a tremendous contrast there is between these two, however. Neptune, at magnitude 7.7, cannot be seen without the help of a telescope. And the telescope, with magnification of over 100 diameters, will only reveal a dull, tiny disc. It is closest to the earth the 25th, at 2724 million miles.

HELIOCENTRIC POSITIONS OF THE PLANETS, APRIL



The planets are shown in their respective orbits. Two positions, one for the first, and one for the last day of the month are given for Mercury, Venus, Earth, and Mars. The arrow indicates the last day of the month. Jupiter, Saturn, Uranus, Neptune, and Pluto are shown in their mean position for the current month.

ASTRONOMICAL CALENDAR

Eastern Standard Time

APRIL, 1958

April 3—	4:37 am	Minimum of Algol
4—	4:— pm	Saturn stationary in Right Ascension
4—	10:39 pm	Conjunction, Jupiter and Moon; Jupiter north 1° 52'
5—	7:23 am	Conjunction, Neptune and Moon; Neptune north 1° 37'
6—	1:27 am	Minimum of Algol
6—	10:— am	Mercury stationary in Right Ascension
8—	6:— pm	Venus greatest elongation west, 46° 23'
8—	9:10 pm	Conjunction, Saturn and Moon; Saturn south 2° 53'
8—	10:16 pm	Minimum of Algol
11—	7:05 pm	Minimum of Algol
13—	7:53 am	Conjunction, Mars and Moon; Mars south 6° 37'
14—	3:54 pm	Minimum of Algol

14— 7:26 pm Conjunction, Venus and Moon; Venus south 4° 9'
15— 7:— am Uranus stationary in Right Ascension
16— 2:— pm Inferior conjunction, Mercury and Sun; Mercury north 1° 54'
17— 2:— am Opposition, Jupiter and Sun
17—12:43 pm Minimum of Algol
18—12:— am Venus in descending node
18— 2:10 pm Conjunction, Mercury and Moon; Mercury north 0° 49'
18——:— Annular eclipse of the Sun
20— 9:32 am Minimum of Algol
23— 6:21 am Minimum of Algol
23— 2:— pm Mercury in descending node
23— 9:— pm Opposition, Neptune and Sun
26— 3:10 am Minimum of Algol
26— 9:55 pm Conjunction, Uranus and Moon; Uranus north 6° 6'
28— 5:— am Quadrature, Uranus and Sun
28—10:— pm Mercury stationary in Right Ascension
28—11:59 pm Minimum of Algol

AMATEUR'S FORUM

BY IRVING L. MEYER, M. S.

MAY, 1958

THE SUN: commences the month in Aries, and climbs high into Taurus. It is 93.6 million miles from the earth the 1st, increasing to 94.2 million miles the 31st.

THE MOON: is closest to the earth twice this month; on the 2nd at 223,000 miles, and the 30th at 226,000 miles. It is farthest the 14th at 252,000 miles.

Libration: Maximum exposure of the regions on the Moon's limbs takes place as follows:

May 8 West limb, 6.9°
May 9 South limb, 6.8°
May 23 East limb, 5.9°
May 24 North limb, 6.7°

The Moon's Phases (E.S.T.):

Full Moon	May 3 at 7:23 am
Last Quarter	10 at 9:37 am
New Moon	18 at 2:00 pm
First Quarter	25 at 11:38 pm

There is a partial eclipse of the Moon on the 3rd, visible, at least in part, over western North America, the Pacific Ocean, eastern Asia, Australia, and Antarctica. This is a very poor eclipse, little better than an appulse, as, at maximum, only 1½% of the Moon's diameter is eclipsed. The maximum eclipse will appear practically as a smudge on the limb of the Moon. Circumstances of the eclipse follow (E.S.T.):

Moon enters penumbra	May 3 at 5:10 am
Moon enters umbra	3 at 7:00 am
Middle of eclipse	3 at 7:13 am
Moon leaves umbra	3 at 7:26 am
Moon leaves penumbra	3 at 9:16 am

MERCURY: travels from Pisces, through Aries to the Taurus boundary. In the morning sky all month, it reaches greatest elongation west of the Sun on the 14th. It can be seen for a number of days before and after this date in the morning sky, very close to the horizon (eastern) as dawn breaks. As a guide, it rises about an hour after Venus, and at a point 5° north of Venus. Mercury is bright—magnitude 0.7 at elongation—but the writer has always found that this planet can best be observed in broad daylight with a large telescope. Naturally, setting circles are necessary to locate the planet. Distance the 1st is 59 million miles, increasing to 103 million miles the 31st.

VENUS: still holds forth in the morning sky. Brilliant, unequaled by any other star-like object, it presents a dazzling gibbous disc in the telescope. Like Mercury, it is best observed in broad daylight, when the light of the sky reduces the glare of the planet. Venus is apparently cloud-shrouded, and since the sunlight falling on it is very great by reason of its nearness to the Sun, the combination in our night sky results in scintillating brilliance. During the month it crosses the equator, moving from the Aquarius-Pisces boundary, to the western edge of Aries. Distance from the earth continues to increase—from 80 million miles the 1st, to 101 million miles the 31st.

MARS: is a bright, redish object, rising not long after midnight. Daily coming closer to the earth, and better placed for observation, it moves through Aquarius all month, to a point on the Pisces boundary just south of the equator. Magnitude increases from 0.9 to 0.6 during the month, at the same time distance decreases from 135 to 118 million miles. The planet averages 87% illuminated—noticeably gibbous in the telescope—and 7" diameter.

JUPITER: remains in Virgo in the evening sky. The most brilliant night object and rivalling Venus in splendor, it is an ideal planet for amateur study. Binoculars will reveal the motions of the brighter moons (refer to the charts of there motions, elsewhere in this issue) while a telescope of modest size will show the markings on the disc, as well as the polar flattening and the eclipses and transits of the briight satellites. Distance the 15th is 422 million miles.

SATURN: in Ophiuchus, rises a few hours after sunset. Rivaling Jupiter and Mars in telescopic interest, this planet has a unique and vast ring system. Widely opened this year, Cassini's Division will be easy for any telescope. Titan, the brightest satellite, is also easy, and a 4-inch telescope will reveal several more. To the naked eye, Saturn shines at 0.4 magnitude during the month; very few objects are brighter. Distance the 15th is 852 million miles.

URANUS: high in the northern heavens, in Cancer, is still observable in the evening sky. Close to the borderline of naked-eye visibility, it is at best a relatively uninteresting planet. It presents a neat, round disc under 50 to 100 diameters magnification. Distance the 15th is 1739 million miles.

NEPTUNE: an 8th magnitude, evening-sky object, in Virgo, not far from Jupiter. Not visible to the unaided eye, it can be seen as a faint star in small telescopes. Distance the 15th is 2730 million miles.

ASTRONOMICAL CALENDAR

Eastern Standard Time

MAY, 1958

May 1— 8:48 pm Minimum of Algol
2— 4:21 am Conjunction, Jupiter and Moon; Jupiter north 2° 11'
2— 5:14 pm Conjunction, Neptune and Moon; Neptune north 1° 41'
3——:— Partial eclipse of the Moon
3— 9:— pm Mercury in aphelion
4— 5:37 pm Minimum of Algol
6— 5:22 am Conjunction, Saturn and Moon; Saturn north 2° 49'
7— 2:26 pm Minimum of Algol
10—11:15 am Minimum of Algol
12— 9:58 am Conjunction, Mars and Moon; Mars south 6° 7'
13— 8:04 am Minimum of Algol
14— 9:— am Mercury greatest elongation west, 25° 1'
14— 7:25 pm Conjunction, Venus and Moon; Venus south 3° 46'
16— 4:53 am Minimum of Algol
16— 9:16 am Conjunction, Mercury and Moon; Mercury south 3° 33'
19— 1:42 am Minimum of Algol
21—10:31 pm Minimum of Algol
22— 8:— am Venus in aphelion
24— 4:— am Mercury greatest heliocentric latitude south
24— 4:38 am Conjunction, Uranus and Moon; Uranus north 6° 0'
24— 7:20 pm Minimum of Algol
27— 4:09 pm Minimum of Algol
29— 9:25 am Conjunction, Jupiter and Moon; Jupiter north 2° 17'
30— 1:38 am Conjunction, Neptune and Moon; Neptune north 1° 42'
30—12:58 pm Minimum of Algol

ANNULAR ECLIPSE OF THE SUN, APRIL 18

This eclipse can be seen from Alaska, and from the Hawaiian Islands. It cannot be seen from the United States proper, nor from Canada. All times are expressed in PACIFIC Standard Time (8 hours slow on Greenwich) but additional conversion to local time will be necessary for some of the listed locations.

ANCHORAGE, ALASKA:
Beginning of eclipse, ... 8:05 pm
Middle of eclipse, ... 8:44 pm
End of eclipse, ... 9:22 pm
Maximum eclipse, 20%

FAIRBANKS, ALASKA:
Beginning of eclipse, ... 8:06 pm
Middle of eclipse, ... 8:39 pm
End of eclipse, ... 9:11 pm
Maximum eclipse, 13%

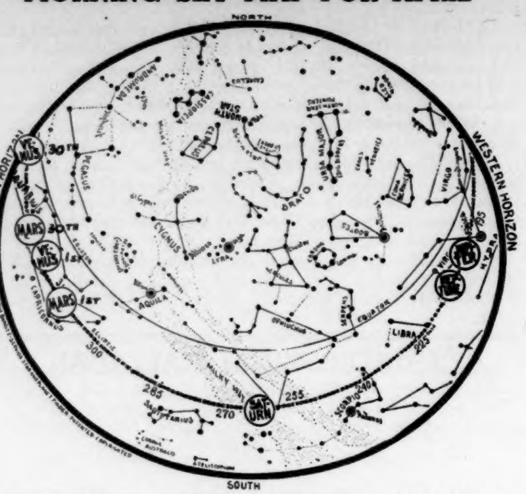
NOME, ALASKA:
Beginning of eclipse, ... 8:00 pm
Middle of eclipse, ... 8:41 pm
End of eclipse, ... 9:20 pm
Maximum eclipse, 18%

For the following two locations, the Sun sets before the middle of the eclipse is reached. The maximum figure given is that at time of sunset:

JUNEAU, ALASKA:
Beginning of eclipse, ... 8:06 pm
Maximum eclipse, 11%

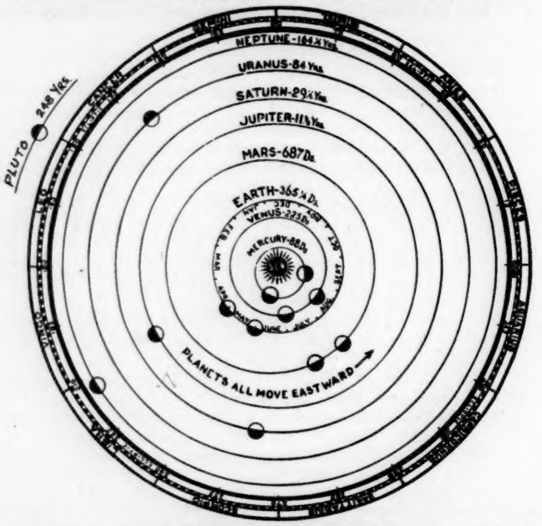
HONOLULU, HAWAII:
Beginning of eclipse, ... 8:20 pm
Maximum eclipse, 43%

MORNING SKY MAP FOR APRIL



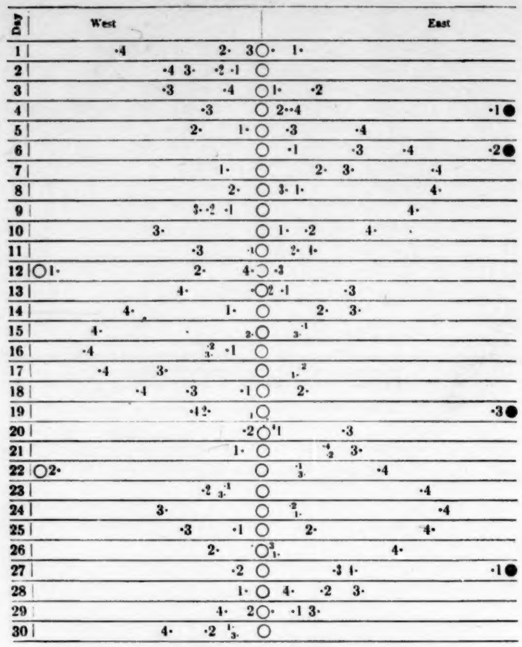
At 5:00 A.M., April 1; 4:00 A.M., April 15; 3:00 A.M., April 30

HELIOCENTRIC POSITIONS OF THE PLANETS, MAY



SATELLITES OF JUPITER

APRIL



Appearance of Jupiter and its satellites at 1:00 A.M., E.S.T. as seen in an inverting telescope

AMATEUR'S FORUM

BY IRVING L. MEYER, M. S.

JUNE, 1958

THE SUN: passes its high point in the northern heavens, as it moves from Taurus into Gemini. Distance increases from 94.2 the 1st, to 94.4 million miles the 30th.

THE MOON: is farthest from the earth the 11th at 251,000 miles, and is closest the 26th at 229,000 miles.

Libration: Maximum exposure of the regions on the Moon's limbs takes place as follows:

June 5	West limb,	6.0°
June 5	South limb,	6.7°
June 18	East limb,	5.2°
June 20	North limb,	6.6°

The Moon's Phases (E.S.T.):

Full Moon	June 1	3:55 pm
Last Quarter	9	1:59 am
New Moon	17	2:59 am
First Quarter	24	4:44 am

MERCURY: is not observable all month. It begins as a morning sky object, is in superior conjunction with the Sun on the 18th, and thereafter is an evening sky object, very close to the Sun at all times. It moves from the Aries-Taurus boundary, through the latter, into Gemini. Distance from the earth reaches a maximum on the 19th, at 123 million miles.

VENUS: the prime attraction in the late morning sky, moves from the Pisces-Aries boundary, into Taurus at a point fairly close to the Pleiades. It is now on its way toward a rendevous with the Sun (superior conjunction) in November, but is still well placed for observation. Distance increases from 101 million miles the 1st, to 120 million miles the 30th. However, the illuminated area of the disc increases from 72% to 81%, so that magnitude decreases only from -3.5 to -3.4.

MARS: is approaching quadrature. It remains in Pisces all month, crossing the equator into the northern hemisphere. It is a bright, ruddy planet, increasing in brilliance from 0.6 to 0.3 magnitude. It is close to its most gibbous phase (85% illuminated), meaning that its 8" diameter disc will look noticeably out-of-round in even a small telescope. Still too far away for detection of detail on the surface in any but the largest telescopes. Distance decreases from 117 million miles to 102 million miles during June.

JUPITER: still the most interesting object in the evening sky. Above the horizon at sunset, it sets shortly after midnight. It presents the largest planetary disc at this time (40") with polar flattening and cloud belts readily seen with modest equipment. The four bright satellites are always easy objects and full of interest. Distance the 15th is 454 million miles. In Virgo all month, very close to Spica.

SATURN: comes to opposition the 13th, in Ophiuchus. This is one of two ideal types of opposition, one being when the rings are completely level and hence invisible, the other being this one—the rings opened to their maximum. Saturn is just about as bright as it can become—magnitude 0.2. Actually, Saturn is close to aphelion—farthest from the Sun; a half revolution from now, the rings again will be widest opened, and Saturn will be closest to the Sun (and to the earth) and slightly brighter. Telescope users at this opposition will enjoy a fine view of the rings. The globe of the planet seems to float within them. Saturn is closest to the earth the 14th at 840 million miles, giving it an apparent diameter (equatorial) of almost 17". The rings are 42" wide.

URANUS: in Cancer all month, sets shortly after dark. It is soon to come into conjunction with the Sun, and enter the morning sky. Distance the 15th is 1780 million miles.

NEPTUNE: still very well placed for observation in the night sky. It is not visible to the naked eye and is, in fact, difficult to detect when compared to the many similar-appearing stars. In Virgo all month. Distance the 15th is 2757 million miles.

AN OBSERVATORY AT 80,000 FEET

By Donald C. Morton

Princeton University Observatory

Astronomers have long been anxious to make observations from outside our atmosphere in order to study the extensive regions of the spectrum that never reach the earth's surface, and to eliminate the blurring of images caused by atmospheric turbulence. Already rockets have carried astronomical instruments as high as 200 kilometers, although for periods no longer than 5 minutes, and before long artificial satellites will form permanent extra-terrestrial observatories. In the meantime, however, the extremely stable platform provided by a ballon at high altitudes has many applications, especially in obtaining well-defined images.

D. E. Blackwell and D. W. Dewhirst from England and A. Dollfus from France, in November 1956 and April 1957 sent an 11-inch refracting telescope suspended from a balloon to 20,000 and 25,000 feet respectively. On the second flight Dollfus, riding in a gondola, piloted the balloon and guided the telescope to obtain photographs of the sun with somewhat better resolution than any taken at mountain-top observatories.

Three flights to 80,000 feet this past summer and fall climaxed five years of design and construction on a similar project to photograph the solar granulation under the direction of Professor Martin Schwarzschild of the Princeton University Observatory, and sponsored by the United States Office of Naval Research. The United States Air Force contributed funds for the development of the pointing control. These flights have already been described in a paper presented at the 99th meeting of the American Astronomical Society by M. Schwarzschild, J. B. Rogerson, Jr., and J. W. Evans.

The Princeton flights, now referred to as Project Stratoscope, differed from those already mentioned in two major respects. First a mechanism which automatically guided the telescope on the sun made extra equipment for the welfare of a human pilot unnecessary, and the vibration resulting from his motions, (even breathing would disturb the system) was eliminated. Secondly the 80,000-foot altitudes were well above the turbulent regions in the tropopause around 40,000 feet.

The motive for these first stratoscope flights arose from Professor Schwarzschild's researches on the solar granulation. Observations of intensity distributions and velocities coupled with certain theoretical considerations indicated that the turbulent eddies in the solar atmosphere should be about 250 kilometres in diameter. Owing to the turbulence in our own atmosphere the very best earth-bound photographs have shown no eddies smaller than about 700 kilometres across. Professor Schwarzschild suspected that these were really clumps of smaller ones and tried to verify this with a 12-inch telescope, which without atmospheric disturbances could resolve elements as small as 250 kilometres.

The guiding mechanism for the telescope was designed and built by the Research Service Laboratories of the University of Colorado. This group already had much experience from constructing solar pointing controls for rocket-borne instruments. The figure shows the telescope tube mounted in a gimbal structure about 12 feet high on axis which permitted motion in elevation and azimuth. Small photosensitive cells searched out the sun and controlled the electric motors the moved the telescope. The telescope was aimed in azimuth by rotating the gimbal structure against the reaction of a 175-pound flywheel, and in elevation by rotating the tube against the reaction of the whole framework. At the top of the figure can be seen the six four-volt automobile batteries distributed around the circumference which served as the weight for the flywheel and also as power to drive the pointing motors, the electronic controls, and the camera. Boxes of styrofoam, a soft foam-like plastic, enclosed the batteries and components of the pointing mechanism to insulate them from the temperatures of —60°C. at 80,000 feet.

Both the framework and the flywheel were permitted to rotate relative to the shroud lines of a 90-foot-long cargo parachute which were hooked to a bearing immediately above the flywheel. Attached to the upper end of the parachute was a giant plastic balloon manufactured by General Mills Inc. of Minneapolis. The balloon, made from transparent polyethylene only 0.002 inch thick, was 139 feet in diameter, 200 ft. in length, and had a capacity of 1,092,000 cubic feet.

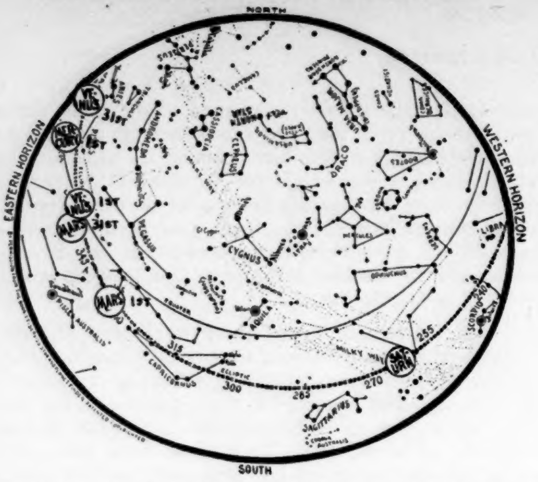
At the beginning of last August the stratoscope crew arrived in Minneapolis and began to assemble and test the instrument for its first flight on an old airfield just north of the city. This flight was not intended for photographing the solar surface but rather to send aloft a special test camera to determine the accuracy of the pointing mechanicm before risking the valuable optical parts.

Only two days after the ground tests were completed, at 12:40 a.m. C.D.T. on August 22 a phone call awakened the stratoscope crew. It was Professor Schwarzschild to tell us that we would launch the first balloon at sunrise that morning, since the meteorologist had predicted the necessary clear weather and ground winds less than 10 m.p.h. We hurriedly drove from our motel to the airfield and began a busy five hours of preparations for the flight.

We removed the gimbal from its protecting tent, fixed to the bottom a styrofoam pad 2½ feet thick to help absorb the shock of landing, and carefully carried the 1301-pound structure by truck down the runway to the launching area. There under bright lights powered by a portable generator the General Mills launching crew unrolled on the ground the length of the 685-pound balloon with the lower end into the wind, and attached to this end the 86-pound parachute. The parachute shroud lines were passed over the cab of the launching truck and then hooked to the gimbal structure which was supported in a vertical position by a steel framework on the rear of the truck. The width of the balloon was not unfolded so that the upper quarter could be passed under a pulley three feet wide mounted on a small truck. Helium from the tanks in two large trucks was fed into this upper section which soon began to fill out and rise vertically although the pulley and the launching truck kept the rest of the train in place. As the eastern sky began to brighten the bag contained sufficient helium to lift the total weight of 2,072 pounds and the flow was stopped. Now our stratoscope was almost ready for launching. Two radios were connected, one to act as a beacon for tracking the balloon and to transmit a barometer reading for determining its altitude, the other to telemeter temperatures and other data relating to the performance of the guiding mechanism. Finally two timers were started, the first to turn on the pointing control at altitude and the second to release the parachute and its cargo from the balloon at the end of the flight. Once the balloon was released there was to be no control from the ground.

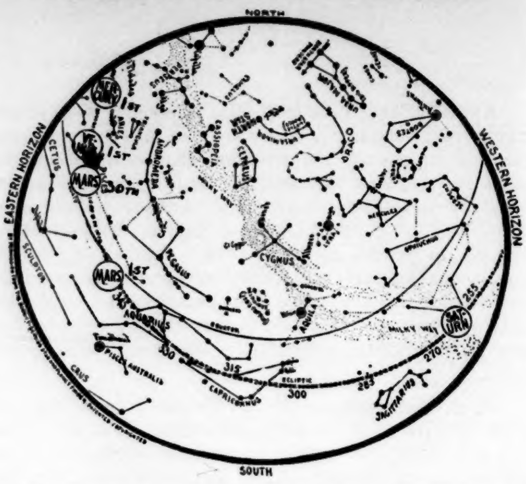
—Continued on Page 8

MORNING SKY MAP FOR MAY



At 5:00 A.M., May 1; 4:00 A.M., May 15; 3:00 A.M., May 31

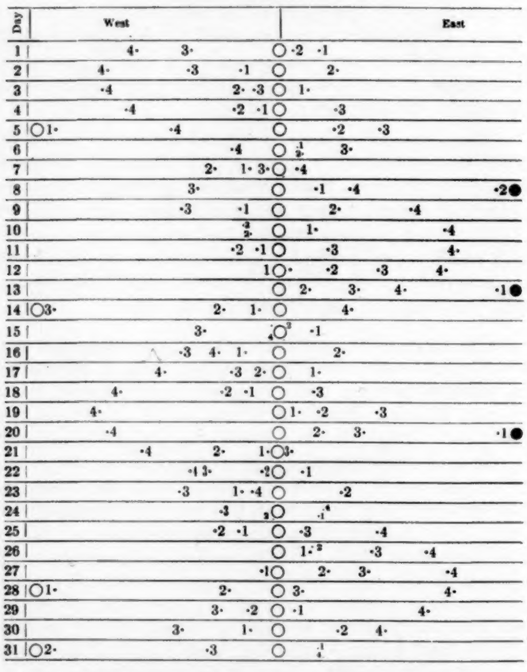
MORNING SKY MAP FOR JUNE



At 5:00 A.M., June 1; 4:00 A.M., June 15; 3:00 A.M., June 30

SATELLITES OF JUPITER

MAY



Appearance of Jupiter and its satellites at 12:00 A.M., (Midnight) E.S.T.

(Note: Midnight is the beginning of the day, not the end of the day.)

as seen in an inverting telescope

Jupiter is represented by the disc in the center of the chart, and each satellite by a dot and its appropriate number. The direction of the staellite's motion is from the dot toward the numeral. The numeral and light disc at the left margin of the chart indicates a satellite in transit across Jupiter's disc; the numeral and dark disc at the right margin indicates a satellite which is invisible because it is being eclipsed or occulted by Jupiter. This chart must be held upside down if binoculars, opera glasses, or an erecting type telescope is used.

Just as the sun appeared above the horizon the launching signal was given. First the balloon was quickly released from the wide pulley permitting the gas-filled upper end to rise although the other end was still attached to the launching truck by the parachute lines. As the lift of the helium carried the balloon up and the wind carried it forward the truck drove along the runway until the instant the balloon, parachute, and gimbal structure were all in a vertical line. Then with a loud crack from an explosive charge the truck released its load and our first stratoscope was on its own at 6:20 a.m. C.D.T. The 300-foot-long train rose quietly and majestically toward the stratosphere.

As the balloon ascended about 800 feet per minute, the tropospheric winds blew it some 30 miles to the east and then the stratospheric winds carried it south and west of Minneapolis. With binoculars we could see the bag becoming more nearly spherical as the helium expanded to fill it, and even with the unaided eye the balloon, at its maximum altitude of 83,100 feet or 15.7 miles, was easily visible from the ground.

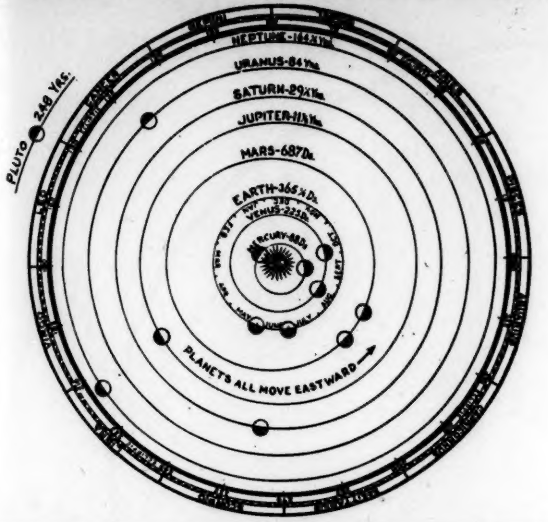
About two hours after launching, we were most pleased to see telemetered signals which indicated the stratoscope had found the sun, first in azimuth and then in elevation, and was keeping the telescope pointed. Soon afterwards we started out in trucks and automobiles to chase the balloon. We followed at an easy pace until 12:20 p.m. when the balloon released the parachute and the stratoscope began to drop; then at top speed over the back roads of Minnesota we drove toward the falling parachute. However, a thick cloud mass which had moved in from the west obscured our view so that we had to depend on direction from an airplane also following the stratoscope.

We found it near Cosmos, Minnesota, about 80 miles west of Minneapolis, in a muddy field, lying on its side, and rather wet because the parachute had dragged it through a small pond. The apparatus, however, suffered remarkably little damage; the impact bent some of the framework and the dragging along the ground twisted the flywheel arms. When the film was developed the next day, it showed conclusively that the guiding mechanism was steady enough to photograph the solar granulation.

After releasing the parachute, the fate of the balloon was as expected. With no load it rose to higher altitudes faster than it could valve helium to equalize its pressure

—*Continued on Page 9*

HELIOCENTRIC POSITIONS OF THE PLANETS, JUNE



with the air outside. The excessive interior pressure soon burst the balloon and the pieces fell some ten miles from the stratoscope.

We began immediately with the preparations for the next flight which would carry aloft the optical system designed and built by the Perkin-Elmer Corporation. The objective was a 12-inch diameter, fused quartz, paraboloidal prime focus was a Newtonian plane mirror mounted on an mirror figured to an accuracy of 1/10 wave-length. At the arm that rotated once every second to prevent the concentrated solar light from overheating the mirror. Thus for axis and cooling. From here the light went to a magnifying 98 per cent. of this period the mirror was off the optical lens, which gave the system an effective focal length of 200 feet, through a totally-reflecting prism, along the top of the telescope tube, and into a 35 mm. movie camera, which took a millisecond exposure each second. Since it was not possible to estimate accurately the effect of the extremely cold air temperature on the length of the telescope tube, the magnifying lens was automatically moved over a range of twenty positions to insure that one in twenty exposures would be in good focus. Altogether about 8,000 photographs were taken.

The second flight was launched at 7:15 a.m. C.D.T. on September 25 again from the old airfield near Minneapolis, and this time the ballon rose to 81,500 feet. Since the stratospheric winds were now blowing from the west they carried the balloon some 140 miles east to near Athens, Wisconsin, where the parachute landed the apparatus at 2:15 p.m. Again the telescope suffered little damage except some bent framework and a chip out of the rotating mirror.

Development of the 1,000 feet of exposed film showed photographs of the solar granulation with a resolution much surpassing all previous ones. A positive copy is reproduced in the figure. Professor Schwarzschild had expected to find that the large eddies were clumps of smaller ones, but instead the stratoscope showed that the solar surface is composed of all sizes of eddies from 700 kilometers and larger which earth-bound photographs have found, down to the minimum possible resolution of 250 kilometers across. Little more can be said of the photographs until they are carefully measured.

For the third flight the guiding mechanism was slightly altered so that during the exposures the telescope moved

—*Continued on Page 10*

ASTRONOMICAL CALENDAR

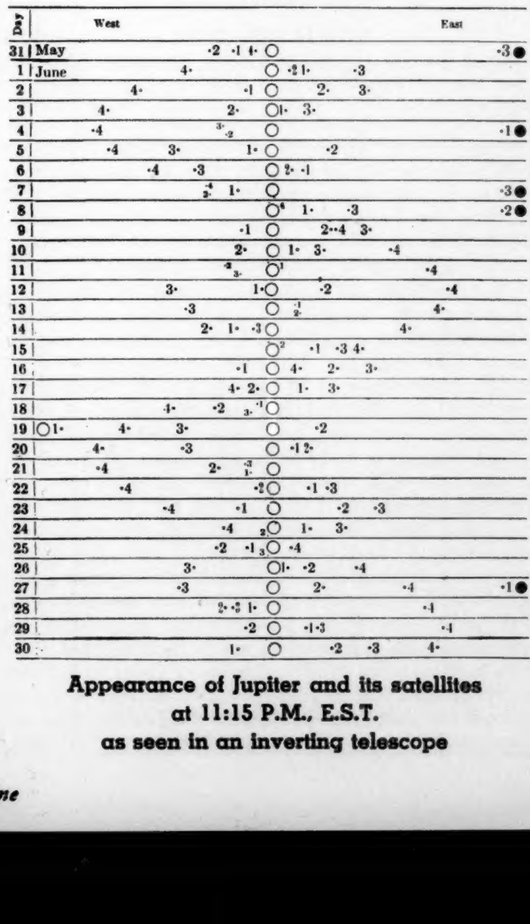
Eastern Standard Time

JUNE, 1958

June 2— 9:47 am	Minimum of Algol
2—12:35 pm	Conjunction, Saturn and Moon; Saturn south 2° 40'
5— 6:35 am	Minimum of Algol
8— 3:24 am	Minimum of Algol
10—11:08 am	Conjunction, Mars and Moon; Mars south 4° 47'
11—12:13 am	Minimum of Algol
12— 5:— am	Mercury in ascending node
13— 6:— pm	Opposition, Saturn and Sun
13— 9:— pm	Venus greatest heliocentric latitude south
13— 9:02 pm	Minimum of Algol
13— 9:31 pm	Conjunction, Venus and Moon; Venus south 0° 47'
14— 2:— am	Mars greatest heliocentric latitude south
16— 5:51 pm	Minimum of Algol
16— 8:— pm	Mercury in perihelion
16—10:40 pm	Conjunction, Mercury and Moon; Mercury north 4° 54'
18— Noon	Superior conjunction, Mercury and Sun; Mercury north 1° 2'
19—11:— am	Jupiter stationary in Right Ascension
19— 2:39 pm	Minimum of Algol
20—12:14 pm	Conjunction, Uranus and Moon; Uranus north 5° 49'
21— 4:57 pm	Sun enters *sign* of Cancer; Solstice
22—11:28 am	Minimum of Algol
25— 8:17 am	Minimum of Algol
25— 2:59 pm	Conjunction, Jupiter and Moon; Jupiter north 2° 2'
26— 7:57 am	Conjunction, Neptune and Moon; Neptune north 1° 34'
27— 3:— am	Mercury greatest heliocentric latitude north
28— 5:05 am	Minimum of Algol
29— 6:10 pm	Conjunction, Saturn and Moon; Saturn south 2° 36'

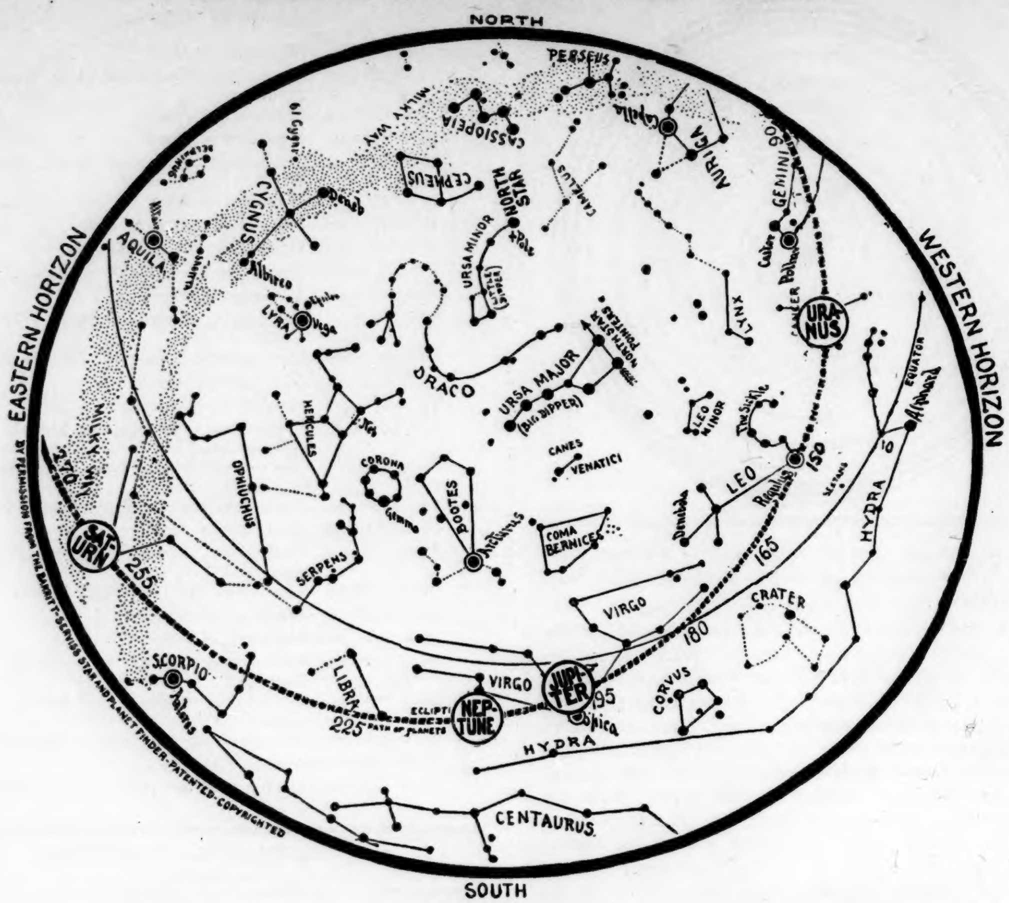
SATELLITES OF JUPITER

JUNE



Appearance of Jupiter and its satellites at 11:15 P.M., E.S.T. as seen in an inverting telescope

EVENING SKY MAP FOR JUNE



AT 9:30 P.M., JUNE 1 — 8:30 P.M., JUNE 15 — 7:30 P.M., JUNE 30

Face South and hold the Map overhead, the top North, and you will see the stars and planets just as they appear in the heavens. The arrow through the two stars in the bowl of the Big Dipper points to the North Star, the star at the end of the handle of the Little Dipper. This map is arranged specifically for Latitude 40 North—New York—but is practical for ten or fifteen degrees north or south of this latitude anywhere in the United States, the southern portion of Canada and the northern portion of Mexico and for corresponding latitudes in Europe.

slowly across the limb of the solar disk. The purposes were to study the granulation there and to measure the limb darkening, that is the gradual decrease in surface brightness near the limb which is a consequence of the light coming from the higher cooler layers of the atmosphere.

For this flight the whole crew moved 250 miles west to Huron, South Dakota, for fear that the stratospheric winds would carry a balloon launched from Minneapolis as far as Lake Michigan. This time the stratoscope was released from Huron at 8:16 a.m. C.D.T. on October 17; it rose to 83,200 feet and the parachute returned the telescope at 3:15 p.m. near Scarville in north-central Iowa. This last landing was not fortunate for the pointing control. The parachute set it down in a small clump of trees, but apparently the horizontal wind carried the parachute with the structure behind through the tree tops until everything crashed some 25 feet to the ground at the edge of the clump. The framework was seriously bent and twisted, acid from the broken batteries was spilled over the apparatus, and the primary mirror was wrenched from its cell and into the telescope tube. However, the mirror itself suffered nothing more than a few scratches in the aluminium surface. The photographs that included the solar limb showed it to be smooth and sharp so that, within the resolution obtained, the granulation has no affect on the appearance of the limb.

With the experience of these three flights Professor Schwarzschild and his colleagues at Princeton are now working on plans to send aloft with the 12-inch telescope a television camera so that the aiming and focusing can be controlled from the ground. This would permit centering the telescope on a sun-spot or some faculae. Also in the planning stage is a 36-inch telescope which some time in 1961 will photograph, or televise for photography on the ground, the surfaces of the planets and the structure of the nebulae. —*Journal of the Royal Astronomical Society of Canada*

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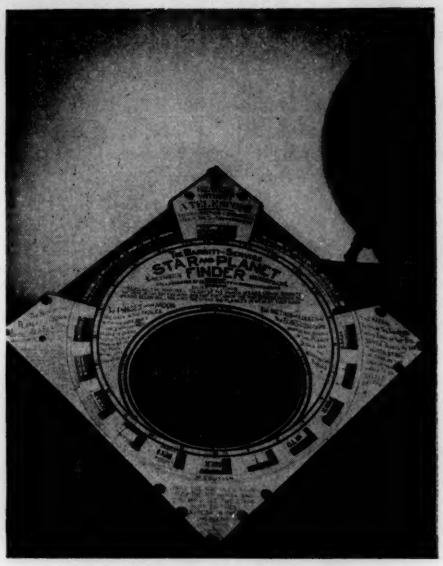

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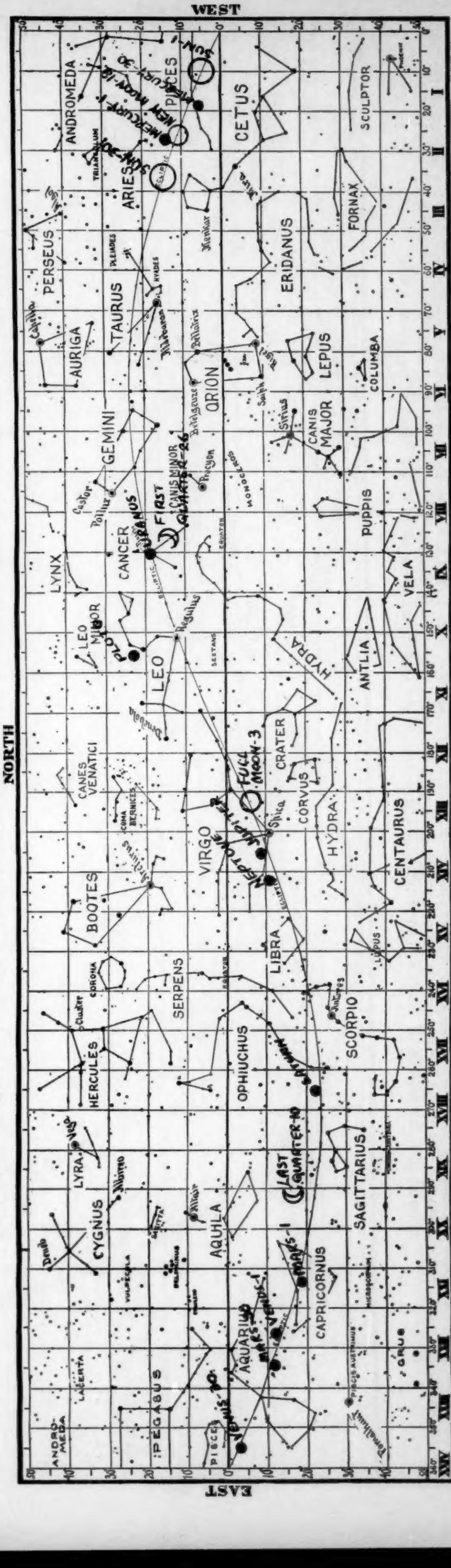


A MERCATOR PROJECTION OF THE STAR FIELD FOR 50° NORTH AND 50° SOUTH OF THE EQUATOR

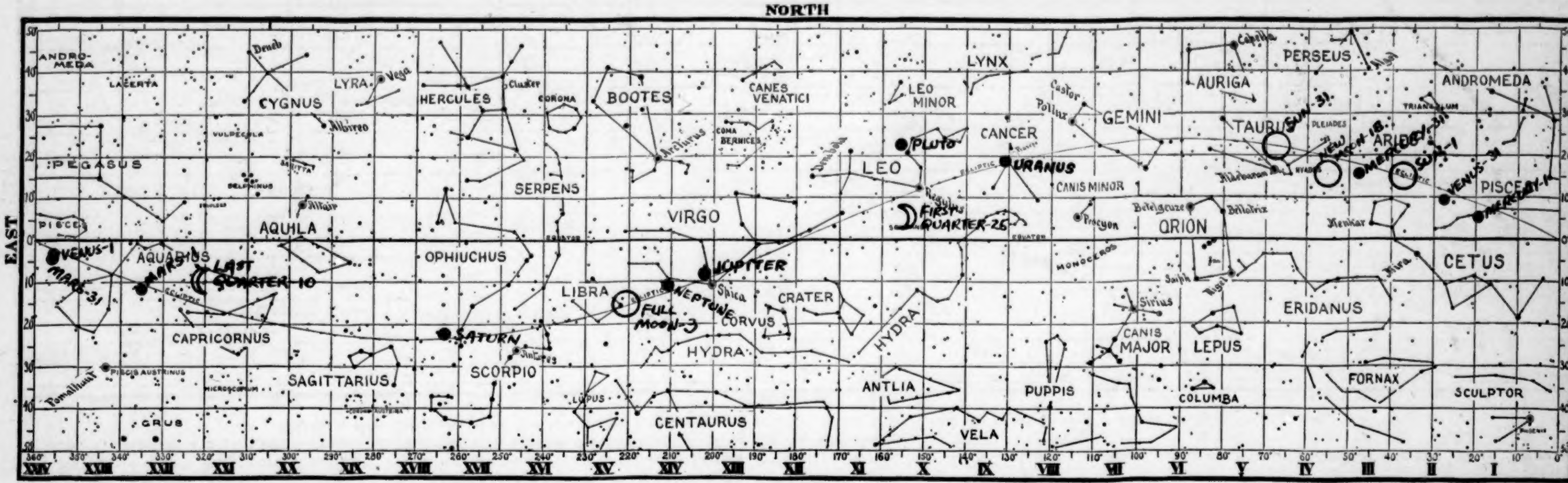
The Star Field makes an apparent complete revolution westward every 24 hours, hence the hourly division from I to XXIV, but this has no relation to the time that any portion of the map is in view. Practical as a Star, Constellation and Planet Finder for the current month—April, 1958—Anywhere in the world.

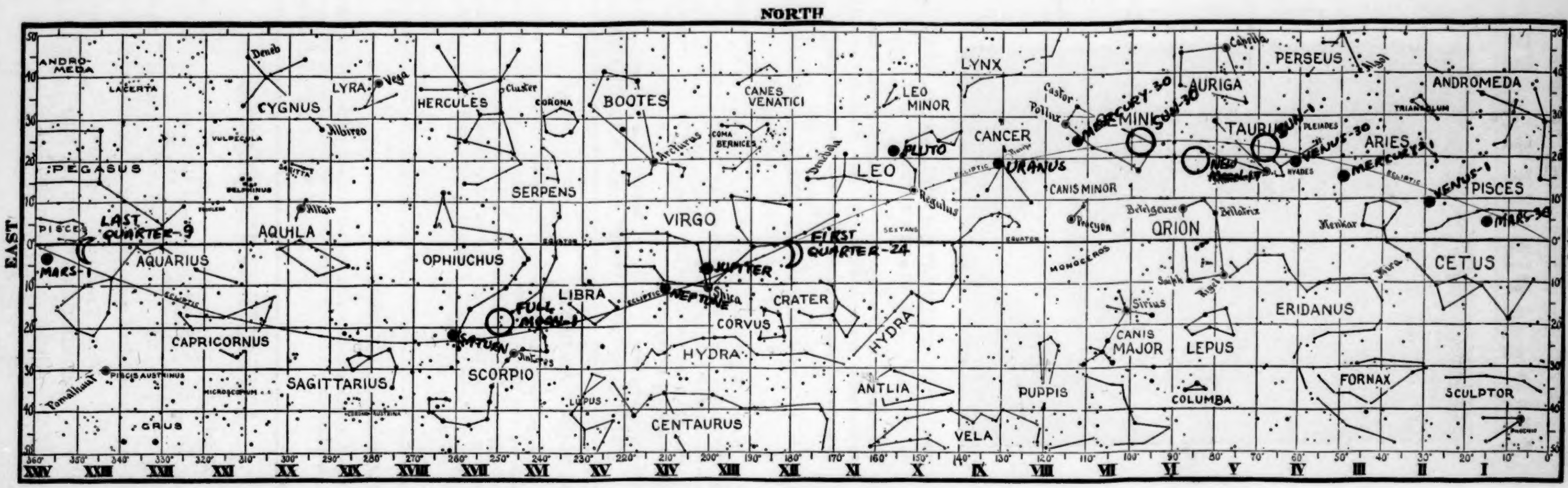
Showing also the position of the Sun at the beginning and ending of the month and the position of the Moon at its several phases.

A MERCATOR PROJECTION OF THE STAR FIELD FOR 50° NORTH AND 50° SOUTH OF THE EQUATOR

The Star Field makes an apparent complete revolution westward every 24 hours, hence the hourly division from I to XXIV, but this has no relation to the time that any portion of the map is in view. Practical as a Star, Constellation and Planet Finder for the current months—May - June, 1958—Anywhere in the world.

Showing also the position of the Sun at the beginning and ending of the month and the position of the Moon at its several phases.





Nov. 5 Oct. 22 Oct. 5 Sept. 20 Sept. 5 Aug. 20 Aug. 5 July 20 July 5 June 20 June 5 May 20 May 5 Apr. 20 Apr. 5 Mar. 20 Mar. 5 Feb. 18 Feb. 2 Jan. 20 Jan. 5 Dec. 20 Dec. 5 Nov. 20

THE DATE BELOW EACH NUMERAL WILL SHOW WHEN THAT SECTION OF THE MAP WILL BE ON THE MERIDAN—DUE SOUTH—AT 9 P.M. OR AN HOUR EARLIER FOR EACH NUMERAL WEST OF THIS DATE AND AN HOUR LATER FOR EACH NUMERAL EAST.